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A Test of a Hypothesis in the Method of Equal Appearing Intervals

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A TEST OF A HYPOTHESIS IN THE METHOD OF EQUAL APPEARING INTERVALS

by

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Vita

Patrick Campbell McAuley was born on April 9, 1944, in Evanston, Illinois. He received his Bachelor of Arts in Mathematics from DePaul University, Chicago, Illinois, in June, 1965, and his Master of Arts in Mathematics from Loyola University, Chicago, in February, 1970.

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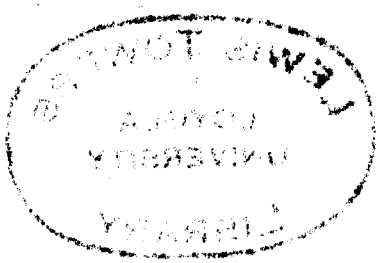

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The monograph by Thurstone and Chave (1929) is a classical treatise on attitude scale construction. In that study, two questions were raised:

1. "We have used the method of equal-appearing intervals for the construction of our scale of attitude. There is some question about the validity of this method since the scale so produced may not be entirely consistent with the scale that would be produced by the method of paired comparison or Cattell's order of merit (rank order) procedure. We leave it for separate experimentation, however, to ascertain to what extent the psychological scales differ when they are produced by the several psycho-physical methods. (p.3)."
2. "Until experimental evidence may be forthcoming on this point, we shall make the assumption that the scale-values of the statements are independent of the attitude distribution of the readers who sort the statements. The assumption is, in other words, that two statements on a prohibition scale will be as easy or as difficult to discriminate for people who are "wets" as for those who are "dry." Given two adjacent statements from such a scale, we assume that the proportion of "wets" who say that statement A is wetter than state-

ment B will be substantially the same as the corresponding proportion for the same statements obtained from a group of "drys." Restating the assumption in still another way, we are saying that it is just as difficult for a strong militarist as it is for a strong pacifist to tell which of two statements is the more militaristic in attitude. If, say, 85 per cent of the militarists declare statement A to be more militaristic than statement B, then, according to our assumption, substantially the same proportion of pacifists would make the same judgment. If this assumption is correct, then the scale is an instrument independent of the attitude which it is itself intended to measure. (p.92)."

With respect to the second question, Upshaw (1965) has demonstrated that the scale values of the statements are invariant over judges up to a linear transformation. Although judges varied in the criterion on attitude, they were equally able to discriminate between statements. The purpose of this study is to answer the first question; that is, can subjects perceive equally spaced intervals and simultaneously judge statements of varying attitude? In this case, the statements to be scaled will be on attitude toward the Church.

The Method of Equal Appearing Intervals (EAI)

In the method described by Thurstone and Chave (1929), each subject was given eleven slips with the respective letters A, B,

C, D, E, F, G, H, I, J, K, written on them. They were then arranged in regular order. Also, each of the 130 statements to be scaled was printed on a separate card and given to the subject (Table I). On slip A the subjects were instructed to put those statements which expressed the highest appreciation of value of the Church; slip F corresponded to the neutral statements; and on slip K the subjects were to place those statements which expressed the strongest depreciation of the Church. On the rest of the slips were arranged the statements in accordance with the degree of appreciation or depreciation expressed in them.

Since the eleven piles were assumed to be equally spaced, then they can be assigned integer values (A=1, ...,K=11). Consequently, for each of the 130 statements there would correspond a distribution function. The scale value for each statement was the median; the measure of variation, Q-value, was estimated as the difference between the 75th centile and 25th centile.

In the instructions (Table II) that were given to the judges, no explicit statement was made that the eleven piles were equally spaced. The reason for this is stated below (Thurstone and Chave, 1929):

> "It is a fundamental important matter that the eleven piles should not be described except to give a starting-point such as neutrality and the two ends. If the eleven piles were defined by descriptive phrases

such as is customary on rating scales of various kinds, the fundamental characteristic of the present measurement method would be destroyed. The reason for this is that the intervals between successive piles should be apparently equal shifts of opinion as judged by the subject. If they were labeled by descriptive phrases such as the steps in a graphic rating scale, the intervals would be defined by the descriptive phrases and there would be no guaranty that the successive intervals appear equal to the subjects. The intervals, if described by the investigator, would be arbitrary and set by him. It is essential that the subject be given the freedom to adjust the slips in the piles so that the intervals in attitude from one pile to the next seem to him to be equal. This is the unit of measurement for the present scale. (pp. 30-31)."

The Law of Comparative Judgment and The Law of Categorical Judgment.

Inherent in the method of paired comparison is the law of comparative judgment (Torgenson, 1958, p. 161)

$$S_i - S_j = X_{ji}(\sigma_i^2 + \sigma_j^2 - 2R_{ji}\sigma_i\sigma_j)^{1/2} \qquad (1)$$

$$(i,j = 1, \ldots N)$$

where: $N = 130$ (Numbers of stimuli)

S_i = Scale value of stimulus i

σ_i = Discriminal dispersion of stimulus i

R_{ji} = Correlation between stimulus i and stimulus j.

X_{ji} = Unit normal deviate corresponding to the proportion of Times stimulus i was judged greater than stimulus j.

One reason that Thurstone and Chave (1929) did not use the method of paired comparison is because each subject would have to make $\frac{N\ (N-1)}{2} = \frac{130 \times 129}{2} = 8{,}385$ judgments. Each stimulus (statement) would be submitted with every other stimulus and the subject would have to determine for each pair which stimulus is more in favor of the Church.

If we remove the restriction in the method of EAI that the category boundaries are constant and consider the category boundaries as stimuli, then by substitution T_g (g = 1, ...K) for S_i in Equation (1), we would then have the law of categorical judgment (Torgenson, 1958, p. 206)

$$T_g - S_j = X_{jg}\ (\sigma_g^2 + \sigma_j^2 - 2R_{jg}\ \sigma_g\ \sigma_j)^{1/2} \qquad (2)$$

where: K + 1 = 11 (Number of categories)

T_g = Mean location of the gth category boundary.

σ_g = Discriminal dispersion of gth category boundary

R_{jg} = Correlation between stimuli J and category boundary g.

X_{jg} = Unit normal deviate corresponding to the proportion of times boundary g was judged higher than stimulus J.

CHAPTER II

METHOD[1].

In 1969, 117 subjects were administered the 130 statements (Table I) developed by Thurstone and Chave , using the first eight of the ten instructions followed by the authors in 1929 (Table II) These 117 subjects were freshmen and sophomores at a midwestern university. By using Thurstone and Chave's criterion that any subject placing "30 or more of the 130 statements in one of the 11 piles" should be eliminated, our final sample reduced to 80 freshmen and 23 sophomores. Of the 103 subjects, 60 were men and 43 were women. (These data were previously analyzed to determine if the shift in scale values of the statements after 40 years was linear (Rimoldi & McAuley, In Press).

Since the complete form of the law of categorical judgment is not solvable, two assumptions were made:

$$1. \quad R_{jg} = 0 \quad (g = 1, \ldots, K), \quad (J = 1, \ldots. N) \qquad (3)$$

$$2. \quad \sigma_g^2 = C \quad (g = 1, \ldots.. K) \qquad (4)$$

Assumption one means that the stimuli are statistically independent category boundaries. Assumption two means the dispersions of the category boundaries are relatively insignificant and that the subjects divide the continuum into the same number of steps, although the steps may vary in size. Thus we arrive at:

$$T_g = S_j + A_j X_{jg} \text{ , for all } j \qquad (5)$$

$$\text{where } A_j^2 = \sigma_j^2 + C \text{ .} \qquad (6)$$

The iterative solution for S_j, A_j, and T_g was used (Diederich, Messick, and Tucker (1957)). This solution proceeds by minimizing the following error term:

$$E = \frac{1}{b^2} \sum_{j=1}^{N} \sum_{g=1}^{K} W_{jg}(S_j + A_j X_{jg} - T_g)^2 \qquad (7)$$

Where: b is an arbitrary scale factor, and W_{jg} is a weight,

$$W_{jg} = \begin{cases} 0 \text{ for } |X_{gj}| > 3.0 \\ 1 \text{ for } 3.0 \geq |X_{jg}| \geq 2.0 \\ 2 \text{ for } |X_{jg}| < 2.0 \text{ .} \end{cases}$$

Let $\hat{T}_{gp}$ denote the p^{th} iterative approximation to the true T_g. The criterion that I chose for convergence was

$$\sum_{g=1}^{K} (\hat{T}_{gp} - \hat{T}_{g\ p-1})^2 \leq 0.0009 \text{ .}$$

The criterion for convergence that I chose was arbitrary. I could just as well have used .05 or .00000009. For the solution of the data in this study, four iterations were necessary.

After convergence was obtained, a linear transformation of the category boundaries was computed:

$$U_g = A \hat{T}_{g,4} + C \qquad (8)$$

where: $g = 1, \ldots, K = 10$

$$A = (K-1)/(\hat{T}_{K,4} - \hat{T}_{1,4})$$

$$C = 1 - A\,\hat{T}_{1,4}$$

Next the scale value and relative dispersion for each statement were computed by using equations 36 and 39 in Diederick et al., 1957 p. 166. The first three columns of Table III are respectively the statement number, the scale value , and the relative dispersion (Q-value) for each statement. In Table III columns A through K represent for each statement the proportion of times the subjects judged a particular statement to be below a particular boundary. Thus for statement 12 on page 35, .14% of the judges placed that statement below the G^{th} boundary.

CHAPTER III

RESULTS AND DISCUSSION

t_g (g=1,...,K) shall denote the integer mean location of the category boundaries which Thurstone and Chave (1929) assumed; and u_g (g=1,...,K) will be the mean location of the category boundaries obtained from the law of categorical judgement in this study.

Hypothesis: Judges who scale statements which vary in attitude on a continuum are unable to perceive equally spaced categories.

It should be noted that if the hypothesis above is false, then:

$$\Delta u_g = u_{g+1} - u_g = a(t_{g+1} - t_g) = a(\Delta t), \quad (g=1,...,K) \qquad (9)$$

The solution of this first order difference equation is $u=at+c$. In other words, there would be a linear relation between the mean locations of the category boundaries obtained in this study and those assumed by Thurstone and Chave (1929).

In Figure I, the domain is the mean locations $(t_g, g=1,...,10)$ assumed by Thurstone and Chave (1929). The co-domain is the mean locations $(u_g, g=1,...,10)$ obtained in this study (Table IV). Denote the relation between t_g and u_g by $T(t_g)=u_g, g=1,...,10$. Upon visual inspection, the black dots which are the coordinates of the points $(t_g, T(t_g))$ seem to follow a curved path along the

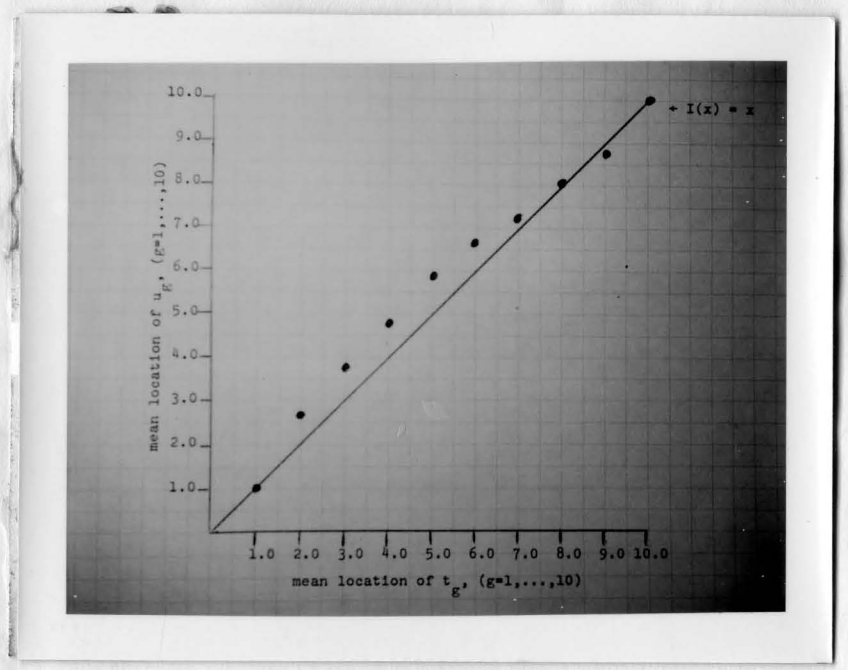
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
mean location of u_g, (g=1,...,10)
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0
mean location of t_g, (g=1,...,10)
← I(x) = x

Figure I

function I(x)=x. In order to test for dimensionality of the function $T(t_g)$, orthogonal polynomials of degree s, were used (Wendroff, 1966, pp. 14-19), so that:

$$u_s(t)=C_oQ_o(t)+C_1Q_1(t)+\ldots+C_iQ_i(t)\ldots+C_sQ_s(t) \qquad (10)$$

Where: s = degree of the polynomial

t = mean location of the category boundary assumed by Thurstone & Chave

C_i = coefficient of the orthogonal polynomial of i degree

$Q_i(t)$ = $(t-A_i)Q_{i-1}(t)-B_{i-1}Q_{i-2}(t)$

Where: $A_i = [\sum_{g=1}^{K} t_g \{Q_{i-1}(t_g)\}^2] / D_{i-1}$

$B_{i-1} = \{\sum_{g=1}^{K} t_g Q_{i-1}(t_g Q_{i-1}(t_g)\} / D_{i-2}$

$D_i = \sum_{g=1}^{K} \{Q_i(t_g)\}^2$

$Q_o(t)= 1$

$Q_{-1}(t)=0$

The difference between the predicted $u_s(t)$ (Equation 10) and the actual u_g obtained was tested by using "Wilks' test" (Ralston, 1965, p. 235), so that:

$$\sigma_s^2 = \sum_{g=1}^{K} (u_g-u_s(t))^2/(N-s-1), \qquad (11)$$

Where: N= number of data points

Since in practice we don't know the actual function which describes the true relation for our data points, all we can do

is to try several different functions and examine their residuals. According to "Wilk's Test," one chooses a particular function over several other alternatives if for that particular function its residual variance is less than the residual variances of the other alternative functions.

In the writer's case, the following σ^2s were obtained:

$\sigma_1^2 = .09148$ $\sigma_2^2 = .03718$ $\sigma_3^2 = .00609$ $\sigma_4^2 = .00508$ $\sigma_5^2 = .00174$
$\sigma_6^2 = .00090$ $\sigma_7^2 = .00139$.

These variances of the residuals indicate that the data can be better explained by means of a 6th degree orthogonal polynomial, the corresponding equation being:

$$u_6(t) = 5.83 + .9462\ Q_1(t) - .0298\ Q_2(t) + .0085\ Q_3(t) + .0008\ Q_4(t) + .0005\ Q_5(t) - .0001\ Q_6(t). \quad (12)$$

What is important to note is not that $u_6(t)$ is a 6th degree polynomial, but that it is not a first degree polynomial. That is, the correspondence between Thurstone's assumed mean locations of the category boundaries and those obtained in this study is not linear. That is sufficient reason to accept as true the hypothesis under examination.

For another empirical proof, define $S(g) = \Delta u_g = u_{g+1} - u_g$. If the categorical boundaries u_g were perceived to be equally spaced, then $S(g) = H$, $(g=1,\ldots,9)$, for some constant H. In Figure II, the domain is g, $(g=1,\ldots9)$, and the co-domain is S(g). The

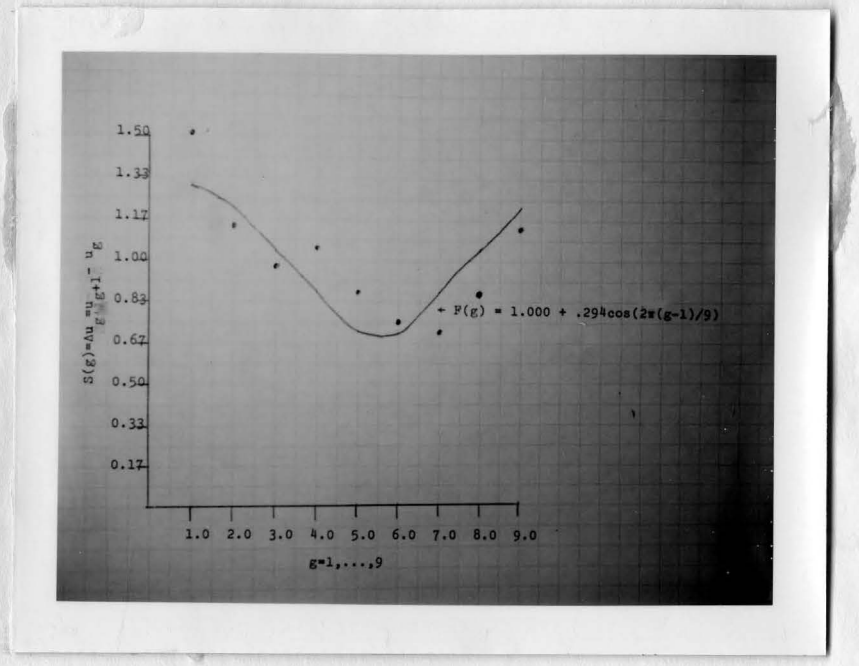
1.50
1.33
1.17
1.00
0.83
0.67
0.50
0.33
0.17
S(g)=n_g^2 - n_{g-1}n_{g+1}
← F(g) = 1.000 + .294cos(2π(g-1)/9)
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
g=1,...,9

Figure II

black dots in the figure represent the coordinates of the points (g,S(g)). Upon visual inspection, the dots follow a sinusoidal curve around the function S(g)=1. Equation 13 gives the trigonometric approximation used to fit the points:

$$F_e = 1/2a_o + \sum_{r=1}^{e} a_r \cos\left(\frac{2\pi(g-1)}{2\ell+1}\right) \quad b_r \sin\left(\frac{2\pi(g-1)}{2\ell+1}\right) \tag{13}$$

Where: $2\ell + 1 = 9$

$e < \ell$

a_o, a_r, b_r are the present coefficients

We tried equation (13) for e = 0, 1. The obtained values were tested for each e, using equation 14, (Ralston, 1965, p. 259).

$$\sigma_e^2 = \frac{R_e}{2(\ell-e)} = \frac{(S(g)-F_e)^2}{2(\ell-e)} \tag{14}$$

The values for equations (14) are as follows:

$$\sigma_o^2 = .0621$$

$$\sigma_1^2 = .0164$$

Next, the residual variance for a_o and a_1 alone was calculated.

$$\sigma^2 = \frac{R}{2-1} = \left\{\sum_{g=1}^{K} S(g)^2 - 9/4a_o^2 - 9/2a_1^2\right\}/7 \tag{15}$$

$$= (.4966 - 9/2(.2939)^2)/7 = .0157$$

Since σ^2 was less than either σ_0^2 or σ_1^2 then

$$F(g) = 1 + .294\cos\frac{(2\pi(g-1))}{9}$$

was determined to be the best fitting trigonometric function according to "Wilk's Test" as explained in the first paragraph on page 12. Consequently, since the least square approximation F(g) to S(g) is not constant, then the hypothesis can be accepted as true.

CHAPTER IV

CONCLUSION

The 103 subjects in this experiment perceiced the first three categories and the last three categories of the continuum to have relatively greater scale separation than the four middle categories. In other words, the three categories on either end are easier for the judges to distinguish than those categories in the middle of the continuum. These results are consistent with a previous study by Rimoldi and McAuley (In Press). In that study, the statements at the extremes showed greater stability after forty forty years than those statements whose scale values were in the middle of the range. It was also shown in the above mentioned study that the statements in the middle of the continuum had relatively higher interquartile range than those at the two ends of the continuum.

Although the scale value for each statement is a function of the category boundaries, it is important to note that the category boundaries are a function of the distribution of the statements (see Equation 5). Taking the first difference of equation 5, with respect to g and letting $\Delta g=1, (g=1,\ldots,9)$, then, for all j:

$$\Delta T_g = \Delta T_g / \Delta_g = A_j \Delta X_{jg} / \Delta_g = A_j \Delta X_{jg} \qquad (16)$$

Holding j constant, then for each statement ΔT_g would be relatively high if and only if ΔX_{jg} is relatively high.

Suppose the difference between the cumulative proportions for two successive categories in each of the three cases below is held constant; i.e., 1%. If the cumulative proportions are either very low (Case 1, 1% and 2%), or if the cumulative proportions are very high (Case 2, 98% and 99%), then the difference between the two corresponding unit normal deviates ΔX_{jg} would be relatively large for either case. Whereas, if two successive cumulative proportions are for Case 3, 50% and 51%, then ΔX_{jg} would be relatively small as shown in Table V. Thus, the ΔT_g would be larger at the two ends of the scale rather than at the middle of the scale for a constant change in cumulative proportions in two successive categories.

The fact that ΔT_g is not constant throughout the continuum neither impugns Thurstone's law of categorical judgment nor is it a negative characteristic in scaling. To the writer, it seems that since extreme or dogmatic statements are easier to place on the continuum rather than neutral or ambiguous statements, then those categories at the two ends of the continuum should have larger scale separation than those categories in the center of the continuum.

CHAPTER V

SUMMARY

Two distinct empirical demonstrations and a mathematical rationale were given to show that the intervals fail to be perceived equally spaced in the method of Equal Appearing Intervals (EAI). Thus the method of EAI which assumes a false premise should not be used as a scaling technique.

Footnote

[1]Since there were no library routines at the computer installations around Chicago, Illinois, which would be of use to the investigator in analyzing the data for this dissertation, he had to write, keypunch, and de-bug three programs. The program for the weighted least-square iterative solution for successive intervals was written in FORTRAN IV for Northwestern University's CDC 3600. Total computer time was 8.44 seconds for the solution of the successive intervals. The two other programs were both written in IITRAN for Illinois Institute of Technology's Univac 1108. Remote entry to IIT's computer was at Loyola University through their on-line teletype at Damen Hall. Total computer time for the solution of the orthogonal polynomial was 0.258 seconds, and for the solution of the least-square Fourier function was 0.045 seconds. For each program, data with known solutions were run to guarantee the accuracy of the program.

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APPENDIX:

STATISTICAL TABLES

TABLE I

LIST OF OPINIONS ABOUT THE CHURCH

1. I have seen no value in the church.
2. I believe the modern church has plenty of satisfying interests for young people.
3. I do not hear discussions in the church that are scientific or practical and so I do not care to go.
4. I believe that membership in a good church increases one's self-respect and usefulness.
5. I believe a few churches are trying to keep up to date in thinking and methods of work, but most are far behind the times.
6. I regard the church as an ethical society promoting the best way of living for both an individual and for society.
7. The paternal and benevolent attitude of the church is quite distasteful to me.
8. I believe the church has a good influence on the lower and uneducated classes but has no value for the upper, educated classes.
9. I don't believe church-going will do anyone any harm.
10. I have no interest in the church for my parents had no religion and I have seen no value in it.
11. I believe in the church and its teachings because I have been accustomed to them since I was a child.

TABLE I (CONTINUED)

12. I feel the churches are too narrow-minded and clannish.
13. I believe in religion but I seldom go to church.
14. I think the church allows denominational differences to appear larger than true religion.
15. I think the church is a good thing. I don't go much myself but I like my children to go.
16. I get no satisfaction from going to church.
17. In the church I find my best companions and express my best self.
18. I am an atheist and have no use for the church.
19. I feel church attendance is a fair index of the nation's morality.
20. I go to church because I enjoy music. I am in the choir and get musical training and chorus-singing.
21. I do not understand the dogmas or creeds of the church but I find that the church helps me to be more honest and creditable.
22. I believe in personal religion but organized religion as represented in the church has no meaning for me.
23. I am interested in a church that is beautiful and that emphasizes the aesthetic side of life.
24. The churches may be doing good and useful work but they do not interest me.

TABLE I (CONTINUED)

25. I believe the churches are doing far more harm than good.
26. I regard the church today as primarily an educational institution.
27. I believe in sincerity and goodness without any church ceremonies.
28. I believe in what the church teaches but with mental reservations.
29. My only interest in the church is in the opportunities it gives for a good time.
30. I believe the church ought to have a value but I regret that I have to quit it as it is.
31. I believe the church promotes a fine brotherly relationship between people and nations.
32. I believe the church is bound hand and foot by money interests and cannot practice the religion of Jesus.
33. I feel the church is petty, always quarreling over matters that have no interest or importance.
34. Sometimes I feel that the church and religion are necessary and sometimes I doubt it.
35. I go to church because my girl does.
36. I believe the churches are too much divided by factions and denominations to be a strong force for righteousness.
37. I am only interested in the church for the sake of the social life I find there.

TABLE I (CONTINUED)

38. I think too much money is being spent on the church for the benefit that is being derived.
39. I believe the church is absolutely needed to overcome the tendency to individualism and selfishness. It practices the golden rule fairly well.
40. I think the teaching of the church is altogether too superficial to have much social significance.
41. I think the country would be better off if the churches were closed and ministers set to some useful work.
42. I believe the church provides most of the leaders for every movement for social welfare.
43. I believe the church represents outgrown primitive beliefs that are based largely on fears.
44. I believe the church is the greatest institution in our country for developing patriotism.
45. Some churches are all right, but others are "all bunk."
46. I do not think the church is essential to Christianity.
47. I like our church for it gives young people a chance to have some fun and yet it is religious.
48. The church represents shallowness, hypocrisy, and prejudice.
49. I do not think one has to belong to the church to be religious.
50. I feel the church services give me inspiration and help me to live up to my best during the following week.
51. I feel I can worship God better out of doors than in the

TABLE I (CONTINUED)

church and I get more inspiration there.

52. I believe interest in the church is more emotional than rational.

53. I feel that the church is rapidly coming to apply scientific methods to its thinking and its promotion of religion.

54. When I go to church I enjoy a fine ritual service with good music.

55. I believe that if young people are not interested in the church it is the fault of either their parents or the church leaders.

56. I believe the church is losing ground as education advances.

57. The church has not helped me to any satisfactory ideas of God or the future. I have had to work out my own ideas.

58. I think one church is about as good as another but some camouflage better than others.

59. I go to church occasionally but have no specific attitude toward it.

60. I believe orthodox religion is all right but radicals upset the influence of the church.

61. I go to church because I find the sermon usually interesting.

62. I am interested in the church because of its work for moral and social reform in which I desire to share.

63. I believe the church would be all right if it kept close to the teachings of Jesus but it does not and so fails.

TABLE I (CONTINUED)

64. I feel the need for religion but do not find what I want in any one church.
65. I think the church is a parasite on society.
66. I think the church is a place for religious instruction of young and old and is essential in every community.
67. I think the church is after money all the time and I am tired of hearing of it.
68. I think the church and organized religion is necessary for the superstitious and uneducated but it should become less and less important.
69. I am careless about religion and church relationships but I would not like to see my attitude become general.
70. I like the opportunity in the young people's society for discussion and self-expression.
71. I think the church is valuable for creating ideals and for setting a person right morally.
72. I think the organized church is an enemy of science and truth.
73. I like to go to church for I get something worthwhile to think about and it keeps my mind filled with right thoughts.
74. I enjoy my church because there is a spirit of friendliness there.
75. I believe the church is the greatest influence for good government and right living.

TABLE I (CONTINUED)

76. The church is to me primarily a place to commune with God.

77. I do not receive any benefit from attending church services but I think it helps some people.

78. I give my money to support the church but I keep out of it because there is so much petty jangling.

79. I believe the church leaders are afraid to stand up and say what is true and right. The church is weak.

80. I enjoy a good church service but do not take much stock in the teachings.

81. If I were picking a man for a responsible job I would give the preference to a regular church-member.

82. The church does not interest me now but sometime I expect I shall find it worthwhile to join.

83. I am attracted to the church by its courageous attack on what is commonly called impossible.

84. I find the social life of the church too slow and uninteresting and that is all I care about.

85. I believe the church has done and can do far more for society than any organization of science.

86. My belief is that the church is more spiritual and a greater force for good than it was a hundred years ago. It is increasing in value.

87. I think the church is hundreds of years behind the times and cannot make a dent of modern life.

TABLE I (CONTINUED)

88. I like church occasionally but do not feel that one should get too ardent about worship or church-going.
89. I believe the church has grown up with the primary purpose of perpetuating the spirit and teachings of Jesus and deserves loyal support.
90. I like the ceremonies of my church but do not miss them much when I stay away.
91. I regard the church as the institution for the development of spiritual life individually and socially.
92. I believe the church is far removed from the essentials of Christian love and brotherly kindness.
93. I believe church-membership is almost essential to living life at its best.
94. I believe the church is as necessary as the school for our social life.
95. I do not believe in any brand of religion or in any particular church but I have never given the subject serious thought.
96. I regard the church as a static, crystallized institution, and as such it is unwholesome and detrimental to society and the individual.
97. I think the church is learning more and more how to correlate science and religion for the good of humanity.
98. No one attempts to live up to the ideals of the church but it serves as a good stimulator.

TABLE I (CONTINUED)

99. To me the church is more or less boring.

100. I believe the church is a powerful agency for promoting both individual and social righteousness.

101. I believe the church is the greatest institution in America today.

102. I have no desire to attend, join, or have anything to do with any church I know.

103. I find the services of the church both restful and inspiring.

104. I find more satisfaction in doing church work than in anything else I do.

105. I think the church is more controlled by magic than by reason.

106. I believe the average of the morals of church-members is considerably higher than the average of non-church-members in the same social status.

107. The church is needed to develop religion which has always been concerned with man's deepest feelings and greatest values.

108. I believe the church is full of hypocrites and have no use for it.

109. I never want to miss church for I always get an inspiration from a good church service.

110. I think the church keeps business and politics up to a

TABLE I (CONTINUED)

11. I think the average church has a deadening influence and prevents true religion.
12. I believe in the ideals of the church but I am tired of denominationalism.
13. I feel the church perpetuates the values which man puts highest in his philosophy of life.
14. I believe the church is fundamentally sound but some of its adherents have given it a bad name.
15. I cannot think through the mysteries of religion but like to get the assurances of reality, of God, and immortality that the church gives and stands for.
16. I believe the majority of church-members are shameless hypocrites. They do not practice what they pretend to do and do not care.
17. I believe the church is working steadily for the application of the principles of Jesus to all personal-social relationships.
18. I believe the church is an excellent character-building institution for children.
19. I think the church is a hindrance to true religion for it still depends upon magic, superstition, and myth.
20. I think the church is a divine institution and deserves the highest respect and loyalty.
21. I believe churches are as essential to religion as schools

TABLE I (CONTINUED)

are to education.

122. I think the church is cursed by a narrow-minded, selfish lot of people.

123. I think the church is necessary but it puts its emphasis on the wrong things.

124. I support the church because I think it is the most unselfish and idealistic institution in society.

125. I respect any church-member's beliefs but I think it is all "bunk."

126. I believe the church develops friendships and ideals that help one to reject low and evil purposes and acts.

127. I think the church seeks to impose a lot of worn-out dogmas and medieval superstitutions.

128. My experience is that the church is hopelessly out of date.

129. I believe the church is doing a good work but will have to work on a seven-day-a-week program if it is going to keep up with the job.

130. I believe the church is a changing human institution but it has divine realities behind it. The spirit of God moves through it.

TABLE II

DIRECTIONS FOR SORTING SLIPS

1. The 130 slips contain statements regarding the value of the church. These have been made by various persons, students, and others.
2. As a first step in the making of a scale that may be used in a test of opinions relating to the church and religion we want a number of persons to sort these 130 slips into eleven piles.
3. You are given eleven slips with letters on them, A, B, C, D, E, F, G, H, I, J, K. Please arrange these before you in regular order. On slip A put those statements which you believe express the highest appreciation of the value of the church. On slip F put those expressing a neutral position. On slip K put those slips which express the strongest depreciation of the church. On the rest of the slips arrange statements in accordance with the degree of appreciation or depreciation expressed in them.
4. This means that when you are through sorting you will have eleven piles arranged in order of value-estimate from A, the highest, to K, the lowest.
5. Do not try to get the same number in each pile. They are not evenly distributed.
6. The numbers on the slips are code numbers and have nothing

TABLE II (CONTINUED)

to do with the arrangement in piles.

7. You will find it easier to sort them if you look over a number of the slips, chosen at random, before you begin to sort.

8. It will probably take you about forty-five minutes to sort them.

9. When you are through sorting, please clip the piles together, each with its letter slip on top. Replace the eleven sets, clipped carefully, in the big envelope and return to E. J. Chave, Room 306, Swift Hall, University of Chicago.

10. Put your name and university classification on slip enclosed.

TABLE III

ACCUMULATIVE PROPORTIONS

Statement	Scale-Value	Q	A	B	C	D	E	F	G	H	I	J	K
			1.00	2.51	3.67	4.65	5.70	6.57	7.31	8.02	8.87	10.00	
1	10.9	3.0	.00	.00	.00	.01	.01	.10	.11	.15	.23	.41	1.00
2	4.8	2.0	.02	.16	.28	.54	.65	.74	.85	.96	.99	1.00	1.00
3	7.8	1.3	.01	.01	.02	.02	.03	.11	.34	.57	.83	.96	1.00
4	4.4	1.4	.01	.03	.55	.75	.94	.97	.97	.97	.99	1.00	1.00
5	6.4	1.7	.01	.05	.07	.11	.25	.36	.65	.85	.94	.99	1.00
6	2.1	2.1	.30	.53	.79	.90	.97	.97	1.00	1.00	1.00	1.00	1.00
7	8.1	1.4	.01	.01	.02	.02	.02	.07	.24	.48	.74	.93	1.00
8	7.8	1.7	.00	.01	.01	.03	.14	.17	.36	.57	.79	.89	1.00
9	5.5	1.5	.02	.05	.08	.14	.28	.86	.92	.97	.99	.99	1.00
10	8.4	1.9	.00	.00	.00	.00	.00	.17	.30	.41	.62	.80	1.00
11	6.0	1.8	.02	.03	.06	.12	.47	.68	.77	.85	.95	.98	1.00
12	8.5	1.8	.01	.02	.02	.03	.03	.05	.14	.30	.61	.86	1.00
13	6.9	1.6	.01	.02	.02	.04	.17	.37	.67	.78	.87	.98	1.00

TABLE III (CONTINUED)

ACCUMULATIVE PROPORTIONS

State-ment	Scale-Value	Q	A	B	C	D	E	F	G	H	I	J	K
			1.00	2.51	3.67	4.65	5.70	6.57	7.31	8.02	8.87	10.00	
14	7.3	1.3	.01	.01	.03	.03	.06	.12	.45	.76	.88	.99	1.00
15	6.0	1.6	.00	.00	.04	.22	.54	.70	.84	.89	.95	.98	1.00
16	8.2	2.0	.01	.02	.02	.03	.05	.15	.39	.48	.68	.80	1.00
17	3.7	2.0	.09	.26	.45	.71	.83	.91	.97	.99	1.00	1.00	1.00
18	9.7	4.0	.00	.00	.00	.00	.00	.24	.26	.32	.41	.54	1.00
19	5.1	2.1	.00	.10	.25	.39	.58	.88	.90	.92	.96	.97	1.00
20	6.5	1.8	.00	.01	.05	.10	.39	.57	.76	.84	.89	.95	1.00
21	4.3	1.8	.04	.14	.35	.64	.85	.90	.93	.98	1.00	1.00	1.00
22	7.4	1.6	.00	.01	.03	.04	.07	.22	.47	.71	.83	.96	1.00
23	5.9	2.1	.02	.07	.12	.17	.49	.69	.81	.88	.92	.96	1.00
24	7.1	1.4	.00	.00	.00	.03	.17	.43	.59	.76	.88	.98	1.00
25	9.7	1.5	.00	.00	.00	.01	.01	.03	.05	.08	.26	.61	1.00
26	5.6	1.8	.01	.04	.13	.29	.55	.73	.85	.92	.96	.99	1.00
27	6.6	2.0	.04	.05	.06	.08	.17	.30	.60	.80	.90	.97	1.00

TABLE III (CONTINUED)

ACCUMULATIVE PROPORTIONS

State-ment	Scale-Value	Q	A	B	C	D	E	F	G	H	I	J	K
			1.00	2.51	3.67	4.65	5.70	6.57	7.31	8.02	8.87	10.00	
28	5.7	1.8	.02	.04	.08	.22	.51	.66	.84	.92	.96	1.00	1.00
29	7.7	2.0	.00	.00	.00	.04	.23	.36	.48	.57	.68	.84	1.00
30	7.7	1.8	.01	.02	.02	.05	.11	.15	.34	.60	.82	.89	1.00
31	2.5	.20	.23	.42	.81	.88	.97	.98	.98	.98	1.00	1.00	1.00
32	9.4	2.5	.00	.02	.03	.04	.05	.07	.10	.20	.42	.71	1.00
33	8.7	1.4	.00	.00	.00	.00	.01	.07	.15	.36	.56	.82	1.00
34	6.1	1.3	.00	.01	.06	.11	.20	.80	.90	.95	.98	.99	1.00
35	7.4	1.8	.00	.00	.01	.04	.16	.50	.56	.65	.72	.86	1.00
36	7.6	2.2	.02	.03	.03	.08	.11	.16	.33	.54	.74	.92	1.00
37	7.3	1.9	.00	.00	.00	.00	.20	.32	.51	.69	.80	.92	1.00
38	7.9	1.5	.00	.01	.02	.02	.06	.11	.30	.53	.79	.93	1.00
39	3.1	2.3	.15	.43	.61	.78	.91	.93	.98	.99	.99	.99	1.00
40	8.3	1.4	.00	.00	.01	.01	.05	.08	.20	.44	.65	.91	1.00
41	10.8	2.3	.00	.00	.01	.01	.03	.05	.13	.21	.31	.32	1.00

TABLE III (CONTINUED)

ACCUMULATIVE PROPORTIONS

State-ment	Scale-Value	Q	A	B	C	D	E	F	G	H	I	J	K
			1.00	2.51	3.67	4.65	5.70	6.57	7.31	8.02	8.87	10.00	
42	3.7	1.8	.07	.23	.52	.76	.87	.95	.98	.98	1.00	1.00	1.00
43	9.1	1.4	.01	.01	.01	.01	.02	.02	.09	.18	.38	.79	1.00
44	3.6	2.8	.18	.32	.49	.65	.83	.91	.93	.95	.97	.97	1.00
45	7.8	1.4	.00	.00	.01	.02	.04	.26	.39	.60	.78	.94	1.00
46	8.6	3.2	.03	.05	.06	.09	.12	.15	.24	.42	.60	.76	1.00
47	4.8	1.7	.03	.06	.17	.46	.81	.91	.96	.96	.98	.99	1.00
48	11.7	2.4	.00	.00	.00	.01	.01	.02	.04	.05	.10	.26	1.00
49	6.3	2.1	.02	.07	.14	.14	.19	.44	.68	.83	.89	.97	1.00
50	3.0	2.3	.18	.39	.60	.82	.92	.95	.97	.98	.99	1.00	1.00
51	6.4	1.8	.02	.04	.06	.09	.16	.40	.72	.86	.94	.98	1.00
52	6.7	2.0	.02	.03	.07	.13	.17	.34	.54	.75	.88	.99	1.00
53	4.7	2.1	.03	.16	.32	.53	.68	.84	.91	.95	.98	.98	1.00
54	5.8	1.9	.00	.01	.09	.24	.58	.75	.85	.91	.95	.96	1.00
55	6.0	1.9	.01	.04	.09	.27	.38	.61	.78	.86	.93	.98	1.00

TABLE III (CONTINUATION)

ACCUMULATIVE PROPORTIONS

State-ment	Scale-Value	Q	A	B	C	D	E	F	G	H	I	J	K
			1.00	2.51	3.67	4.65	5.70	6.57	7.31	8.02	8.87	10.00	
56	7.5	1.3	.00	.00	.00	.03	.05	.19	.42	.73	.88	.97	1.00
57	7.8	2.0	.00	.03	.04	.04	.06	.16	.31	.50	.76	.91	1.00
58	7.6	1.5	.00	.00	.00	.01	.07	.33	.49	.64	.79	.93	1.00
59	6.9	1.2	.00	.00	.01	.02	.09	.60	.74	.83	.91	.98	1.00
60	6.2	1.9	.01	.03	.06	.17	.47	.63	.98	.87	.92	.95	1.00
61	5.2	1.7	.01	.05	.13	.41	.75	.85	.89	.94	.99	.99	1.00
62	2.8	2.3	.19	.42	.67	.83	.92	.96	.98	.98	.99	1.00	1.00
63	8.0	1.8	.00	.00	.02	.04	.08	.11	.32	.57	.72	.86	1.00
64	6.7	1.4	.01	.01	.01	.07	.21	.48	.72	.82	.94	.99	1.00
65	12.2	3.4	.00	.00	.01	.03	.03	.05	.05	.08	.12	.32	1.00
66	2.1	2.2	.28	.58	.79	.92	.95	.98	.99	.99	1.00	1.00	1.00
67	9.2	1.7	.01	.01	.01	.02	.02	.04	.11	.24	.45	.70	1.00
68	8.6	1.7	.00	.00	.00	.02	.05	.09	.18	.37	.56	.81	1.00
69	5.8	1.7	.01	.04	.10	.19	.50	.70	.79	.92	.98	1.00	1.00

TABLE III (CONTINUATION)

ACCUMULATIVE PROPORTIONS

State-ment	Scale-Value	Q	A	B	C	D	E	F	G	H	I	J	K
			1.00	2.51	3.67	4.65	5.70	6.57	7.31	8.02	8.87	10.00	
70	4.0	1.9	.07	.21	.40	.60	.76	.95	.98	.98	.99	1.00	1.00
71	2.4	2.2	.19	.52	.77	.91	.95	.96	.98	.99	.99	1.00	1.00
72	10.7	2.5	.00	.00	.00	.02	.02	.05	.07	.10	.17	.46	1.00
73	4.2	1.9	.09	.12	.32	.62	.87	.93	.94	.96	.99	1.00	1.00
74	4.2	1.6	.03	.13	.33	.57	.88	.97	.98	.99	.99	1.00	1.00
75	1.8	2.7	.37	.62	.77	.89	.92	.95	.98	.99	1.00	1.00	1.00
76	2.4	2.7	.28	.51	.70	.80	.93	.97	.98	.98	.98	.99	1.00
77	6.4	1.4	.00	.01	.03	.10	.30	.63	.82	.86	.95	.99	1.00
78	7.7	1.5	.00	.00	.00	.02	.10	.21	.38	.62	.82	.92	1.00
79	8.9	1.6	.00	.00	.00	.01	.03	.05	.14	.27	.53	.76	1.00
80	6.9	1.3	.00	.00	.01	.03	.30	.43	.66	.79	.92	.99	1.00
81	4.8	2.0	.03	.08	.31	.50	.80	.91	.94	.95	.95	.97	1.00
82	6.5	1.4	.00	.01	.02	.06	.31	.66	.76	.85	.96	.98	1.00
83	3.7	2.4	.10	.29	.50	.72	.86	.91	.94	.96	.97	1.00	1.00

TABLE III (CONTINUED)

ACCUMULATIVE PROPORTIONS

State-ment	Scale-Value	Q	A	B	C	D	E	F	G	H	I	J	K
			1.00	2.51	3.67	4.65	5.70	6.57	7.31	8.02	8.87	10.00	
84	8.0	1.5	.00	.00	.00	.00	.00	.15	.34	.60	.74	.88	1.00
85	2.0	2.7	.32	.59	.78	.86	.94	.95	.97	.98	1.00	1.00	1.00
86	2.0	2.5	.25	.52	.78	.90	.96	.98	.98	.99	.99	.99	1.00
87	9.1	2.1	.00	.00	.02	.03	.07	.08	.13	.24	.47	.75	1.00
88	7.0	1.5	.00	.00	.01	.05	.22	.37	.62	.77	.89	.98	1.00
89	2.1	2.2	.28	.59	.81	.88	.98	.98	.98	.99	1.00	1.00	1.00
90	6.8	1.4	.00	.00	.02	.03	.27	.50	.69	.83	.94	.98	1.00
91	2.2	2.7	.29	.50	.74	.85	.92	.97	.98	.98	.99	.99	1.00
92	9.4	2.1	.00	.01	.02	.02	.03	.04	.14	.20	.40	.66	1.00
93	2.0	3.4	.30	.57	.75	.85	.93	.95	.95	.95	.96	.96	1.00
94	3.9	2.3	.11	.26	.44	.60	.79	.92	.94	.95	.98	1.00	1.00
95	7.3	1.2	.00	.00	.01	.01	.03	.56	.68	.76	.85	.96	1.00
96	10.6	1.7	.00	.00	.00	.00	.00	.01	.02	.07	.16	.34	1.00
97	3.4	1.9	.10	.28	.60	.79	.90	.97	.97	1.00	1.00	1.00	1.00

TABLE III (CONTINUED)

ACCUMULATIVE PROPORTIONS

State-ment	Scale-Value	Q	A	B	C	D	E	F	G	H	I	J	K
			1.00	2.51	3.67	4.65	5.70	6.57	7.31	8.02	8.87	10.00	
98	6.2	1.6	.01	.02	.04	.16	.45	.59	.78	.83	.94	.99	1.00
99	7.9	1.4	.01	.01	.01	.01	.05	.13	.47	.65	.77	.87	1.00
100	2.2	1.9	.25	.57	.79	.88	.98	.98	1.00	1.00	1.00	1.00	1.00
101	0.8	3.2	.60	.74	.80	.85	.89	.97	.99	1.00	1.00	1.00	1.00
102	9.3	2.1	.01	.01	.01	.01	.02	.15	.21	.28	.39	.59	1.00
103	4.1	2.1	.08	.17	.36	.66	.88	.95	.95	.96	.97	.99	1.00
104	3.4	2.6	.16	.30	.55	.74	.86	.91	.93	.96	.97	.98	1.00
105	9.1	1.3	.00	.00	.00	.00	.00	.02	.09	.24	.40	.73	1.00
106	4.2	1.8	.03	.17	.36	.63	.83	.93	.95	.98	.99	1.00	1.00
107	2.0	2.0	.28	.60	.81	.92	.97	.99	.99	1.00	1.00	1.00	1.00
108	11.5	3.2	.01	.01	.02	.03	.03	.04	.06	.13	.18	.38	1.00
109	4.0	2.4	.10	.22	.41	.66	.86	.92	.96	.96	.97	.97	1.00
110	4.6	2.2	.00	.13	.29	.59	.77	.84	.88	.94	.97	.98	1.00
111	9.4	1.8	.00	.00	.01	.01	.04	.06	.08	.18	.34	.69	1.00

TABLE III (CONTINUED)

ACCUMULATIVE PROPORTIONS

State-ment	Scale-Value	Q	A	B	C	D	E	F	G	H	I	J	K
			1.00	2.51	3.67	4.65	5.70	6.57	7.31	8.02	8.87	10.00	
112	5.7	2.1	.03	.07	.12	.22	.44	.58	.79	.91	.93	.99	1.00
113	0.6	3.2	.49	.77	.86	.92	.96	.96	.97	.99	1.00	1.00	1.00
114	5.2	2.0	.03	.09	.17	.34	.63	.79	.89	.91	.97	.99	1.00
115	3.7	2.2	.13	.25	.45	.69	.87	.92	.96	.97	.98	1.00	1.00
116	10.1	2.3	.00	.00	.01	.02	.05	.05	.08	.14	.27	.54	1.00
117	2.2	1.9	.29	.53	.77	.92	.96	1.00	1.00	1.00	1.00	1.00	1.00
118	3.3	1.9	.10	.30	.61	.83	.93	.96	.96	.98	1.00	1.00	1.00
119	9.7	1.5	.00	.00	.00	.01	.01	.02	.05	.12	.29	.58	1.00
120	-0.1	3.2	.64	.81	.88	.92	.95	.99	.99	1.00	1.00	1.00	1.00
121	2.5	2.5	.25	.53	.67	.81	.90	.95	.98	.98	1.00	1.00	1.00
122	9.7	3.7	.02	.03	.06	.08	.12	.16	.18	.29	.42	.63	1.00
123	6.4	1.9	.01	.03	.07	.13	.37	.47	.69	.85	.94	.96	1.00
124	2.2	3.1	.34	.54	.65	.82	.90	.93	.94	.97	.98	1.00	1.00
125	8.4	1.4	.00	.00	.00	.00	.02	.10	.25	.39	.59	.86	1.00

TABLE III (CONTINUED)

ACCUMULATIVE PROPORTIONS

Statement	Scale-Value	Q	A	B	C	D	E	F	G	H	I	J	K
			1.00	2.51	3.67	4.65	5.70	6.57	7.31	8.02	8.87	10.00	
126	3.0	1.9	.14	.34	.68	.88	.94	.95	.98	.99	1.00	1.00	1.00
127	8.9	2.0	.00	.00	.02	.03	.05	.06	.17	.26	.50	.78	1.00
128	8.7	1.5	.00	.01	.01	.02	.02	.04	.14	.30	.57	.83	1.00
129	4.7	2.0	.01	.14	.27	.49	.70	.82	.91	.94	1.00	1.00	1.00
130	1.7	2.4	.38	.66	.79	.88	.95	.99	.99	.99	1.00	1.00	1.00

TABLE IV

g	T_g	$\Delta T_g = T_{g+1} - T_g$
1	1.00	1.51
2	2.51	1.16
3	3.67	0.98
4	4.65	1.05
5	5.70	0.87
6	6.57	0.74
7	7.31	0.71
8	8.02	0.85
9	8.87	1.13
10	10.00	

TABLE V

CASE	CUMULATIVE PROPORTIONS		X_{jg}	X_{jg+1}	ΔX_{jg}
1	1%	2%	-2.33	-2.05	.28
2	50%	51%	0.00	0.02	.02
3	98%	99%	2.05	2.33	.28

APPROVAL SHEET

The dissertation submitted by Patrick C. McAuley has been read and approved by members of the Department of Psychology.

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

5/27/70
Date

William A. Hunt
for Horacio Rimoldi
Signature of Advisor